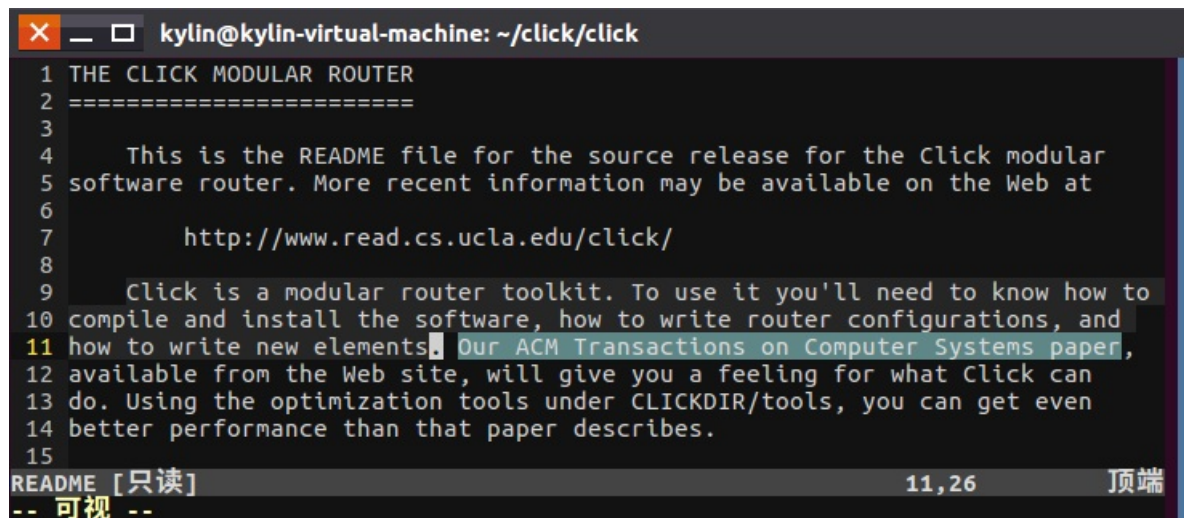


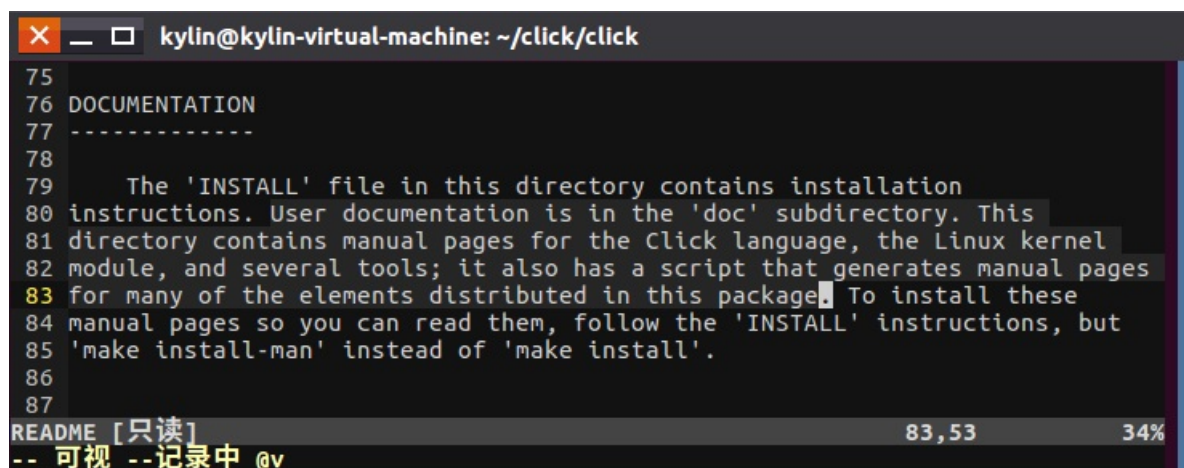
关于click帮助文档的几点说明

首先阅读README文档，README文档在图1中将Click的使用分成三个方面编译安装、路由器配置、编写elements。
并给出官网的相关paper，链接地址"<https://pdos.csail.mit.edu/papers/click:tocs00/paper.pdf>"
(还有一个更详细的版本"<https://pdos.csail.mit.edu/papers/click:kohler-phd/thesis.pdf>")



```
kylin@kylin-virtual-machine: ~/click/click
1 THE CLICK MODULAR ROUTER
2 =====
3
4 This is the README file for the source release for the Click modular
5 software router. More recent information may be available on the Web at
6
7 http://www.read.cs.ucla.edu/click/
8
9 Click is a modular router toolkit. To use it you'll need to know how to
10 compile and install the software, how to write router configurations, and
11 how to write new elements. Our ACM Transactions on Computer Systems paper,
12 available from the Web site, will give you a feeling for what Click can
13 do. Using the optimization tools under CLICKDIR/tools, you can get even
14 better performance than that paper describes.
15
README [只读] 11,26 顶端
-- 可视 --
```

图1. README文档之Click概述



```
kylin@kylin-virtual-machine: ~/click/click
75
76 DOCUMENTATION
77 -----
78
79 The 'INSTALL' file in this directory contains installation
80 instructions. User documentation is in the 'doc' subdirectory. This
81 directory contains manual pages for the Click language, the Linux kernel
82 module, and several tools; it also has a script that generates manual pages
83 for many of the elements distributed in this package. To install these
84 manual pages so you can read them, follow the 'INSTALL' instructions, but
85 'make install-man' instead of 'make install'.
86
87
README [只读] 83,53 34%
-- 可视 --记录中 @v
```

图2. README中对Click相关文档的介绍

README文档在图2中详细描述了随源码一起提供的各种帮助文档。

- 包括编译安装的帮助文档“INSTALL”；
- Click配置语言的manual pages；
- 一些相关工具的manual pages；
- 以及源码中发布的各个elements的manual pages。

下面就按照这里的分类，分别介绍这些文档。

Click编译安装

直接用vim（或其它编辑器）打开阅读INSTALL文档即可。

Click配置语言

```
kylin@kylin-virtual-machine: ~/click/click
87
88 RUNNING A CLICK ROUTER
89 -----
90
91 Before playing with a Click router, you should get familiar with the
92 Click configuration language. You use this to tell Click how to process
93 packets. The language describes a graph of "elements", or packet processing
94 modules. See the 'doc/click.5' manual page for a detailed description, or
95 check the 'conf' directory for some simple examples.
96
97 Click can be compiled as a user-level program or as a kernel module for
98 Linux. Either driver can receive and send packets; the kernel module
99 directly interacts with device drivers, while the user-level driver uses
100 packet sockets (on Linux) or the pcap library (everywhere else).
101
README [只读] 92,29 40%
-- 可视 --
```

图3. README中介绍Click配置语言

README文档在图3的中给出了Click configuration language的帮助文档位置，但这个这个文档不是直接用vim打开读的，它在编译安装的时候（见图4）被cp到\$(mandir)/man5/目录下了，所以要用"man 5 click"命令阅读。命令执行输出见图5。

```
kylin@kylin-virtual-machine: ~/click/click/doc
44 install-man: testie.1 $(ELEMENTMAP) Makefile
45 $(call verbose_cmd,$(mkinstalldirs) $(DESTDIR)$ (mandir)/man1 $(DESTDIR)$ (mandir)/man3 $
46 $(call verbose_cmd,$(INSTALL_DATA) $(srcdir)/click.1 $(DESTDIR)$ (mandir)/man1/click.1,I
47 $(call verbose_cmd,$(INSTALL_DATA) $(srcdir)/click.5 $(DESTDIR)$ (mandir)/man5/click.5)
48 $(call verbose_cmd,$(INSTALL_DATA) $(srcdir)/click.o.8 $(DESTDIR)$ (mandir)/man8/click.o
49 $(call verbose_cmd,$(INSTALL_DATA) $(srcdir)/click-align.1 $(DESTDIR)$ (mandir)/man1/cli
50 $(call verbose_cmd,$(INSTALL_DATA) $(srcdir)/click-combine.1 $(DESTDIR)$ (mandir)/man1/c
51 $(call verbose_cmd,$(INSTALL_DATA) $(srcdir)/click-devirtualize.1 $(DESTDIR)$ (mandir)/m
52 $(call verbose_cmd,$(INSTALL_DATA) $(srcdir)/click-fastclassifier.1 $(DESTDIR)$ (mandir)
53 $(call verbose_cmd,$(INSTALL_DATA) $(srcdir)/click-flatten.1 $(DESTDIR)$ (mandir)/man1/c
54 $(call verbose_cmd,$(INSTALL_DATA) $(srcdir)/click-install.1 $(DESTDIR)$ (mandir)/man1/c
55 $(call verbose_cmd,$(INSTALL_DATA) $(srcdir)/click-mkmindriver.1 $(DESTDIR)$ (mandir)/ma
56 $(call verbose_cmd,$(INSTALL_DATA) $(srcdir)/click-pretty.1 $(DESTDIR)$ (mandir)/man1/cl
57 $(call verbose_cmd,$(INSTALL_DATA) $(srcdir)/click-uncombine.1 $(DESTDIR)$ (mandir)/man1
58 $(call verbose_cmd,$(INSTALL_DATA) $(srcdir)/click-undead.1 $(DESTDIR)$ (mandir)/man1/cl
59 $(call verbose_cmd,$(INSTALL_DATA) $(srcdir)/click-uninstall.1 $(DESTDIR)$ (mandir)/man1
60 $(call verbose_cmd,$(INSTALL_DATA) $(srcdir)/click-xform.1 $(DESTDIR)$ (mandir)/man1/cli
61 $(call verbose_cmd,$(INSTALL_DATA) $(srcdir)/elementdoc.7 $(DESTDIR)$ (mandir)/man7/elem
62 $(call verbose_cmd,$(INSTALL_DATA) testie.1 $(DESTDIR)$ (mandir)/man1/testie.1)
63 $(call verbose_cmd,$(PERL) $(srcdir)/click-elem2man -l -m $(DESTDIR)$ (mandir) -P DEFAULT
64
Makefile.in [只读] 64,0-1 53%
```

图4. 编译安装中将man手册文件拷贝到man目录下


```
kylin@kylin-virtual-machine: ~/click/click/doc
CLICK(5) File Formats Manual CLICK(5)

NAME
    click - Click configuration language

DESCRIPTION
    The Click language is used to describe Click router configurations.

    Two fundamental statements suffice to describe any router: declarations
    introduce elements, and connections define packet flow between them.
    If you think of a Click router configuration as a directed graph of
    elements, declarations list the graph's vertices and connections list
    its edges.

    A declaration looks like this:

        name :: class(config);

    This introduces an element called name that has element class class and
    configuration arguments config.

    A connection looks like this:

        name1 [port1] -> [port2] name2;

    This says that name1's output port port1 connects name2's input port
    port2. The two names must refer to previously declared elements, and
    the two ports must be nonnegative integers.

Manual page click(5) line 1 (press h for help or q to quit)
```

图5. Click配置语言man手册

Click tools

Click编译安装的时候会安装一些tools（见图6）及其相关文档（见图7）。

大部分工具可以直接使用man命令查询它们的帮助。

个别没有man手册的工具可以使用-h选项查看帮助。

举个例子，查看click命令的帮助，直接执行"man click"即可，命令执行输出见图8。

```
kylin@kylin-virtual-machine: /usr/local/bin
kylin@kylin-virtual-machine:/usr/local/bin$ ll | grep "click"
-rwxr-xr-x 1 root root 23404240 11月 9 12:46 click*
-rwxr-xr-x 1 root root 4877720 11月 9 12:47 click2xml*
-rwxr-xr-x 1 root root 5288248 11月 9 12:47 click-align*
-rwxr-xr-x 1 root root 46489 11月 9 12:47 click-buildtool*
-rwxr-xr-x 1 root root 4836200 11月 9 12:47 click-check*
-rwxr-xr-x 1 root root 4998920 11月 9 12:47 click-combine*
-rwxr-xr-x 1 root root 11066 11月 9 12:47 click-compile*
-rwxr-xr-x 1 root root 5963344 11月 9 12:47 click-devirtualize*
-rwxr-xr-x 1 root root 43261 11月 9 12:47 click-elem2man*
-rwxr-xr-x 1 root root 5370672 11月 9 12:47 click-fastclassifier*
-rwxr-xr-x 1 root root 4816456 11月 9 12:47 click-flatten*
-rwxr-xr-x 1 root root 17276 11月 4 20:06 click-mkelemmap*
-rwxr-xr-x 1 root root 5096736 11月 9 12:47 click-mkmindriver*
-rwxr-xr-x 1 root root 5403120 11月 9 12:47 click-pretty*
-rwxr-xr-x 1 root root 4927056 11月 9 12:47 click-uncombine*
-rwxr-xr-x 1 root root 5062592 11月 9 12:47 click-undead*
-rwxr-xr-x 1 root root 5027224 11月 9 12:47 click-xform*
-rwxr-xr-x 1 root root 10052384 11月 4 21:55 clicky*
-rwxr-xr-x 1 root root 5102528 11月 9 12:47 xml2click*
kylin@kylin-virtual-machine:/usr/local/bin$
```

图6. 安装的click tools

```
kylin@kylin-virtual-machine: /usr/local/man/man1
kylin@kylin-virtual-machine:/usr/local/man/man1$ ll | grep click
-rw-r--r-- 1 root root 6213 11月 9 12:47 click.1
-rw-r--r-- 1 root root 2410 11月 9 12:47 click-align.1
-rw-r--r-- 1 root root 4498 11月 9 12:47 click-combine.1
-rw-r--r-- 1 root root 3691 11月 9 12:47 click-devirtualize.1
-rw-r--r-- 1 root root 3643 11月 9 12:47 click-fastclassifier.1
-rw-r--r-- 1 root root 2446 11月 9 12:47 click-flatten.1
-rw-r--r-- 1 root root 5436 11月 9 12:47 click-install.1
-rw-r--r-- 1 root root 3830 11月 9 12:47 click-mkmindriver.1
-rw-r--r-- 1 root root 14325 11月 9 12:47 click-pretty.1
-rw-r--r-- 1 root root 1710 11月 9 12:47 click-uncombine.1
-rw-r--r-- 1 root root 3700 11月 9 12:47 click-undead.1
-rw-r--r-- 1 root root 1003 11月 9 12:47 click-uninstall.1
-rw-r--r-- 1 root root 6907 11月 9 12:47 click-xform.1
kylin@kylin-virtual-machine:/usr/local/man/man1$
```

图7. 安装的click tools的man手册

```
kylin@kylin-virtual-machine: ~/click/click/doc
CLICK(1)                                General Commands Manual                                CLICK(1)

NAME
    click - Click user-level driver

SYNOPSIS
    click [options] [param=value ...] [router-file]

DESCRIPTION
    The click driver executes a Click modular router specification in a
    user-level program. It reads a router configuration file, sets up the
    router according to that file, and generally continues until inter-
    rupted. The router configuration is written in the Click language (see
    click(5)), and can contain dynamically loadable code, which click will
    link against before installing the configuration.

    The click program can read and write packets from the network using
    Berkeley Packet Filters -- see FromDevice.u(n) and ToDevice.u(n). It
    can also read and write BPF dump files, such as those created by tcp-
    dump(1) -- see FromDump(n) and ToDump(n). The InfiniteSource(n) ele-
    ment, and others like it, may be useful for testing configurations
    without affecting the network.

Manual page click(1) line 1 (press h for help or q to quit)
```

图8. click命令的man手册

Click elements

查看已有element的帮助文档

编译安装源码的时候大部分element的man手册都已经被安装好了，可以直接执行man命令查看（如图9所示）。

如果遇到还没有man手册的element，需要用click工具组中的click-elem2man从某element的头文件中提取并生成man手册，该命令的用法可以使用"click-elem2man -h"查看（如图10所示）。


```
kylin@kylin-virtual-machine: /usr/local/share/man/man7
IPPRINT(n)                                IPPRINT(n)
NAME
    IPPrint - Click element; pretty-prints IP packets
SYNOPSIS
    IPPrint([LABEL, KEYWORDS])
    Ports: 1 input, 1 output
    Processing: agnostic
    Package: ip (core)
DESCRIPTION
    Expects IP packets as input. Should be placed downstream of a CheckIP-Header(n) or equivalent element.
    Prints out IP packets in a human-readable tcpdump-like format, preceded by the LABEL text.
Manual page IPPrint(n) line 1 (press h for help or q to quit)
```

图9. 使用man命令查看已有element的man手册

```
kylin@kylin-virtual-machine: ~/click/click/doc
kylin@kylin-virtual-machine:~/click/click/doc$ ./click-elem2man -h
'Click-elem2man' translates Click element documentation into manual pages.
Usage: click-elem2man [-l | -L] [-d DIRECTORY] FILE...
Each FILE is a Click header file, a list of Click header files, or the
output of click-mkelemap. '-' means standard input.
Options:
  -f, --files FILE           Read header filenames from FILE.
  -e, --elementmap EMAP      Read information about other elements from EMAP.
  -d, --directory DIR        Place generated files in directory DIR.
  -m, --man MANDIR           Place generated man pages under MANDIR/manSEC.
  --no-gzip                  Do not gzip generated man pages.
  -P, --package PKG          Elements are in PKG package, or say 'DEFAULT'.
  -l, --list                  Generate the elements(n) manual page as well.
  -L, --extend-list          Extend an existing elements(n) manual page.
  -p, --prefix PFX           Look for header files in PFX after looking in '.'.
  --dokuwiki                 Generate dokuwiki source instead of manual pages.
  --dokuwiki-dl              Generate dokuwiki source using dl plugin.
  -u, --uninstall            Remove existing manual pages.
  -h, --help                 Print this message and exit.
Report bugs to <click@pdos.lcs.mit.edu>.
kylin@kylin-virtual-machine:~/click/click/doc$
```

图10. click-elem2man命令的帮助

编写自己的element

README文档在图11处给出了如何增加elements的说明，更详细的文档需要查看FAQ文件（见图12）。

FAQ文档第113行给出了Click开发手册的文档位置"All these functions are described in the Click programming manual, doc/click.texti."

doc/click.texti文档可以用vim直接打开阅读，也可以用texti2html转成html文件用浏览器打开。

doc/click.texti文档中在图13处给出了programming interface的说明。这个文档可以直接访问doc/click.texti文档中给出的官网链接，也可以把源码中的doc/Doxyfile文件用doxygen跑一下得到html文件，用浏览器打开效果见图14。

```
kylin@kylin-virtual-machine: ~/click/click
176
177 ADDING YOUR OWN ELEMENTS
178 -----
179
180 Please see the FAQ in this directory to learn how to add elements to
181 Click.
182
183
README [只读] 180,16 79%
已查找文件结尾, 再从开头继续查找
```

图11. README文档中关于如何增加element的说明

```
kylin@kylin-virtual-machine: ~/click/click
kylin@kylin-virtual-machine: ~/click/click x kylin@kylin-virtual-machine: ~/click/clic... x + v
76
77 SECTION 3: CREATING YOUR OWN ELEMENTS
78 -----
79
80 Q. How can I add my own element class to Click?
81
82 A. There are two ways to add an element class to Click: in the main Click
83 collection, or in a package. We recommend that you use packages for
84 nontrivial collections of elements. It has several advantages -- for
85 example, it will keep your code separate from the main Click code. Check
86 out the sample package in 'etc/samplepackage'. However, if you just want
87 to compile a single new element, it will be easier to add it to the main
88 Click collection. This answer shows how.
89
90 First, write your element class.
91
92 Each element class should be written as two C++ source files, FILE.cc
93 and FILE.hh. The easiest way to create an element this is to copy an
94 existing element and change the C++ class's name. You must change at
95 least the following function:
96
FAQ [只读] 93,19 37%
```

图12. FAQ文档中关于创建elements的说明

```
kylin@kylin-virtual-machine: ~/click/click
kylin@kylin-virtual-machine: ~/click/click x kylin@kylin-virtual-machine: ~/click/click x + v
FAQ ~/c/c/d/click.texti x
57 @ifinfo
58 This document describes the Click modular router's programming
59 interface. Read this if you're interested in writing new elements for
60 Click. You shouldn't need to read it if you are just building routers
61 that use existing elements.
62
63 Most of Click's programming interface documentation is now stored in
64 the source code as structured comments. The formatted documentation
65 is on the Web: @indicateurl{http://www.read.cs.ucla.edu/click/doxygen}
66 @end ifinfo
67
~/click/click/doc/click.texti [只读] 57,7 3%
输入 :quit<Enter> 退出 Vim
```

图13. click.texti文档中关于programming interface的说明

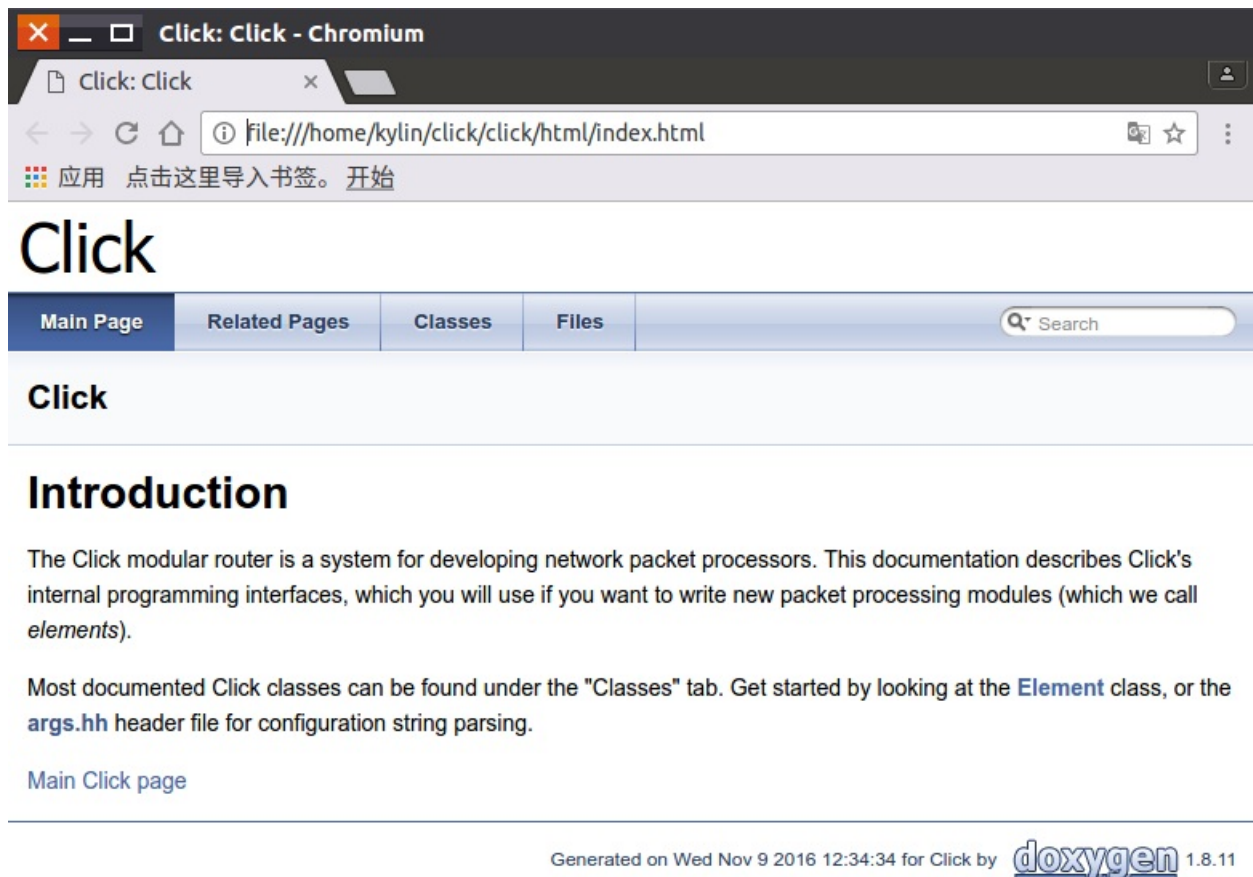


图14. 从本地Doxyfile文件得到的programming interface帮助文档